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# PC-QTRAK: An Automated Tracking System for Environmental Quality Assurance Activities

S-Cubed, La Jolla, CA

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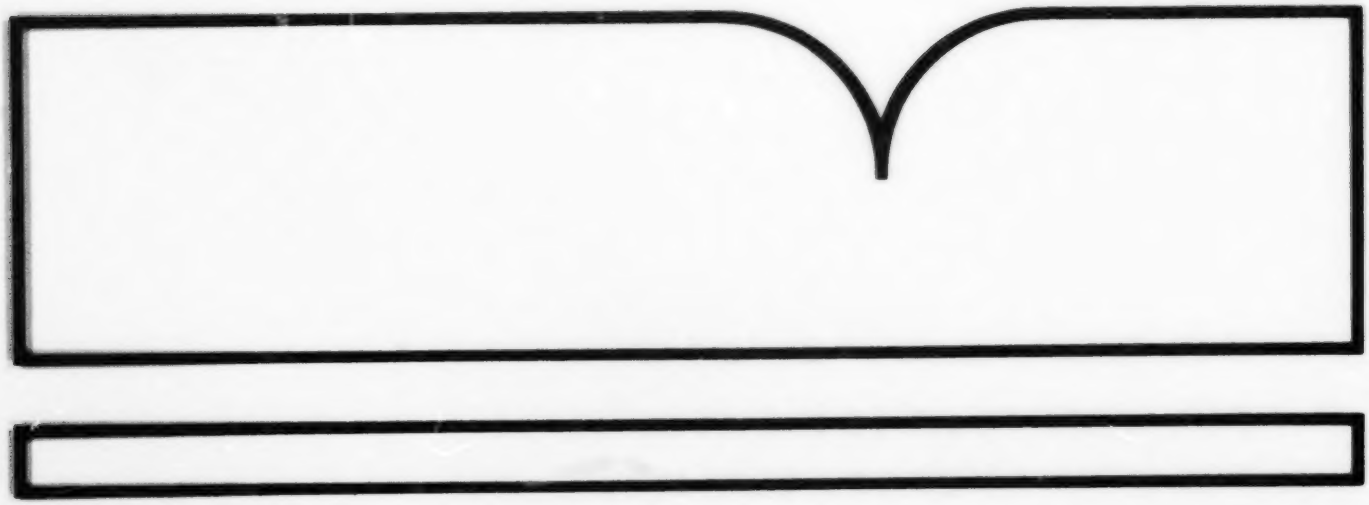

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# PC-QTRAK: AN AUTOMATED TRACKING SYSTEM FOR ENVIRONMENTAL QUALITY ASSURANCE ACTIVITIES

Gary L. Johnson
U.S. Environmental Protection Agency
Quality Assurance Management Staff (MD-49)
Research Triangle Park, North Carolina 27711

Judith S. Ford
U.S. Environmental Protection Agency
Air and Energy Engineering Research Laboratory (MD-49)
Research Triangle Park, North Carolina 27711

Larry E. Michalec
S-Cubed, a Division of Maxwell Laboratories
P.O. Box 1620
La Jolla, California 92038-1620

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EPA Project Officer
Judith S. Ford

AIR AND ENERGY ENGINEERING RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

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16. ABSTRACT The paper discusses PC-QTRAK, an automated tracking system for environmental quality assurance (QA) activities. U.S. EPA policy mandates that QA requirements be established for all Agency programs involving environmental data collection activities. The implementation of this policy is documented by QA Program Plans prepared by each prganization within EPA that is responsible for or involved in environmental data collection. The effectiveness of the QA program is measured by evaluating the implementation of the QA program elements, including data quality objectives, QA project plans, and audits, as applied to hundreds of data collection activities across the Agency. The Quality Assurance Tracking System (QTRAK) offers the QA manager automated tracking that is comprehensive yet totally flexible. PC-QTRAK (providing personal computer--PC--advantages) is applicable to Agency QA programs and may be applicable to states or other organizations with QA program requirements.

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| Quality Assurance | Stationary Sources | 13H, 14D |
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# ABSTRACT

PC-QTRAK: AN AUTOMATED TRACKING SYSTEM FOR ENVIRONMENTAL QUALITY ASSURANCE ACTIVITIES, Gary L. Johnson and Judith S. Ford, USEPA, Research Triangle Park, NC 27711, and Larry E. Michalec, S-Cubed, PO Box 1620, La Jolla, CA 92038.

The U.S. Environmental Protection Agency (EPA) policy mandates that quality assurance (QA) requirements be established for all Agency programs involving environmental data collection activities. The implementation of this policy is documented by QA Program Plans prepared by each organization within EPA that is responsible for or involved in environmental data collection. The effectiveness of the QA program is measured by evaluating the implementation of the QA program elements, including data quality objectives, QA Project Plans, and audits, as applied to hundreds of data collection activities across the Agency. The Quality Assurance Tracking System (QTRAK) offers the QA manager automated tracking that is comprehensive yet totally flexible. PC-QTRAK is applicable to Agency QA programs and may be applicable to States or other organizations having QA program requirements.

## INTRODUCTION

The quality assurance (QA) policy of the U.S. Environmental Protection Agency (EPA) requires that all Agency organizational elements involved in the collection of environmental data develop and implement an effective QA management program to ensure that the data are of documented quality and are adequate for their intended use. This policy[1] is set forth in EPA Order 5360.1, which also requires that such QA management programs be documented in an approved Quality Assurance Program Plan (QAPP).

The QAPP describes the organization's approach to implementing key QA program elements, including data quality objectives (DQOs), QA Project Plan (QAPjP) preparation and review, performance of QA audits, and review of collected data. The effectiveness of the organization's QA program is measured in large part by the successful application of these elements to the environmental data collection activities in which the organization is involved or for which it is responsible.

The management of the QA program is the responsibility of the Quality Assurance Officer (QAO). The concept of an automated tracking system to assist the QAO in managing a QA program had its genesis in 1982 in EPA's Air and Energy Engineering Research Laboratory (AEERL) at Research Triangle Park, NC. The manual tracking of QA implementation for more than 60 engineering R&D projects per year was laborious and time consuming. More importantly, critical QA milestones of some projects were often overlooked because of the large number of projects to monitor and the diversions of other QA responsibilities. To eliminate this problem, a computerized tracking system was developed by AEERL's QA staff with active technical support by S-Cubed, a division of Maxwell Laboratories in San Diego, CA. The tracking system was initially developed for an EPA mainframe computer using a commercially available data base management system and became fully operational for AEERL with the projects for Fiscal Year 1983.

After the successful implementation of the QA tracking system, called QTRAK, in AEERL, its potential application to other EPA organizations was recognized. QTRAK has been tested in a Regional Office pilot program and has since been implemented in two EPA Regions. QTRAK has been adopted by two other research laboratories to aid their QAOs in QA program management. Currently, QTRAK has evolved to a "personal computer" (PC) version that broadens its applicability and utility to QA management programs. PC-QTRAK, as the system is now called, offers more features to the QAO, provides easier access to the tracking data, and enables the QAO to exercise greater control over the system.

This paper describes the development and evolution of QTRAK to PC-QTRAK, discusses the structure and design of PC-QTRAK, and considers the future applicability of PC-QTRAK to EPA, State, or other QA programs.

## WHAT IS QTRAK?

QTRAK (for Quality Assurance Tracking System) is a computerized information system that provides a mechanism for monitoring the status of QA-related activities, including QAPP reviews, audits (e.g., Technical Systems Audits, Performance Evaluations), and reviews of QC documentation in final reports.

The fundamental unit in QTRAK is the task or project that involves environmentally related measurements. Such measurement activities are defined in EPA Order 5360.1 to include "any laboratory or field data gathering activity or investigation involving the determination of chemical, physical, or biological factors related to the environment." While the nature of such activities will vary widely according to the type of data collection activity, media sampled, etc., each activity may be characterized from a data quality management standpoint in terms of milestones. QTRAK is composed of management information variables that describe all phases of the lifespan of a measurement task in terms of data quality so that a user may be able to monitor the QA status of a particular task or tasks. Most important is the flexibility offered by QTRAK that allows the QAO wide latitude in defining a project or data collection activity.

The purpose of QTRAK is to provide a management tool to the QAO to assist in the identification and tracking of the many data collection activities under way in an organization. These activities may be very diverse in nature. Some may be critical programs of high interest to management, such as compliance or rulemaking. Others may produce data leading to significant research findings. As noted earlier, there simply may be many more activities than a QAO with limited staff support can monitor effectively and be able to provide management with timely status reports. QTRAK provides a single repository of information on all QA-related activities that is readily accessible and that may be used to complete such assessments promptly and accurately. This means that needless duplication can be avoided and, more important perhaps, key QA data will not be misplaced or overlooked as has happened with non-automated tracking and filing systems.

Originally, QTRAK was implemented on the SPERRY mainframe computer at EPA's National Computer Center at Research Triangle Park, NC, using SYSTEM 2000, a commercially available data base management system from SAS Institute. In 1986, the "personal computer" version of QTRAK was completed which took advantage of many additional features and capabilities offered by the microcomputer environment that were not available to the mainframe user. PC-QTRAK uses dBase III Plus from Ashton-Tate as the data base manager and the report generator, coupled with full-screen menus for inputting and reviewing data. The menus were written in C programming language for EPA by S-Cubed.

## EVOLUTION OF QTRAK TO PC-QTRAK

QTRAK became fully operational for AEERL in the fall of 1982. As experience in the operation of QTRAK at AEERL grew, other organizations within EPA became interested in applying the QTRAK concept to their QA programs. In particular, the Quality Assurance Management Staff (QAMS) decided to investigate the applicability of QTRAK to Regional QA programs. QAMS, while a part of EPA's Office of Research and Development, is the Headquarters office responsible for management oversight of the implementation of the Agency's QA programs and has been delegated review and approval authority for all organizational QAPPs. QAMS recognized the potential for QTRAK and elected to explore the concept through a pilot exercise involving participation by Regional Offices. In July 1984, the Directors of EPA Regional Environmental Services Divisions were briefed on QTRAK. From this meeting, a pilot program emerged that would involve participation by two

EPA Regions and, after further discussions with several candidate Regions, QTRAK systems were designed for use by the Region 2 QA staff in Edison, NJ, and by the Region 5 QA staff in Chicago, IL.

The QTRAK data base was tested using "real" data supplied by the QAO. Data was loaded into QTRAK during the training phase so that the QAO and related staff could observe the data checking and loading procedures. The AEERL QAO and the S-Cubed project staff conducted on-site training for the two Regions. One of the critical elements of the training phase for the QTRAK staff was to obtain feedback from the users on the applicability of the data base structure and basic report formats to the Region's QA program. In both cases, it was determined that the data base structure and reports would have to be modified in order to make the system fully operational and useful. While the flexibility of SYSTEM 2000 enabled the modifications to be made quickly and economically, it became clear each organization would be unique and that some "tailoring" of the data base would always be needed.

Due to several staffing changes and problems with access to adequate computer facilities, Region 5 was unable to complete the pilot program as planned, but the Region 2 pilot was very successful. The original completion date for the pilot (June 30, 1985) was extended to allow Region 2 to complete several tasks using QTRAK. While there were numerous changes to the data base, NOT ONE change resulted in a radical modification of the basic system design. This suggested that, regardless of organizational structure or mission, there are generic QA activities common to all QA programs in the Agency. The approach offered by QTRAK was to describe these key generic activities in a general manner, then augment this description with special data items unique to the Region's particular needs. When applied to Region 2, the QTRAK data base grew from an initial loading of 160 projects in the fall of 1984 to more than 400 projects in the data base by January 1986.

Early in the Region 2 pilot program, it was found that use of a PC to screen data for entry to the mainframe data base made this process easier and more efficient. After further study, it was concluded that the PC would be the most effective way to enter data to QTRAK. This gave further impetus to the effort begun in early fall 1985 to convert QTRAK to PC-QTRAK.

While the Regional pilot program sponsored by QAMS was in progress, a parallel effort to expand QTRAK in EPA's research laboratory community was begun by AEERL with EPA's Office of Environmental Engineering and Technology Demonstration (OEETD). As a direct result of this activity, QTRAK was implemented at the Hazardous Waste Engineering Research Laboratory (HWERL) in Cincinnati, OH, in 1985. Like AEERL and Region 2, the HWERL QTRAK system began on the mainframe computer, but has since been converted to a PC.

As has been noted, the decision to convert QTRAK to PC-QTRAK was not sudden; rather, it evolved as the maturity of PC use and PC proliferation in the Agency increased. If there was a single factor that forced the issue, it was the reluctance of many QAOs to rely on the mainframe at its off-site location. These QAOs expressed a strong desire to have immediate access to the QTRAK data, and some were concerned about the security of the mainframe. The

obvious solution to both problems was to develop PC-QTRAK, which would allow immediate access to the data and, at the same time, give the QAO complete control over the data.

The development of PC-QTRAK meant the abandonment of SYSTEM 2000 as the data base manager since SYSTEM 2000 did not operate under the PC's Disk Operating System (DOS). Consequently, dBase III Plus from Ashton-Tate was chosen. dBase III was the "standard" PC data base manager for EPA PCs and was widely used in industry. To expedite data entry and enhance data checking for accuracy, S-Cubed created input programs that featured extensive use of multiple screen menus which allowed the user to "page" through the data entry process at the desired pace. The menus also allowed the user to view data already stored in the data base without having to execute a report program to retrieve a dataset. The input programs were written in the C programming language and compiled with the dBase III Plus files to create an integrated program module which could be transported easily to another PC. The design of PC-QTRAK uses the experience gained from Regions and research laboratories. Since there are clear differences between Regions and ORD Laboratories (or Program Offices), two "standard" versions of PC-QTRAK have been developed, one for Regions and one for ORD Laboratories and National Program Offices.

## DESIGN STRUCTURE OF PC-QTRAK

The PC-QTRAK data base consists of the 10 dBase III .DBF files described in Table I. These files are coupled with a like number of index files which identify the key fields upon which each file is indexed. The index files are listed in Table II. The indexing is based on one or more key data items that allow a particular dataset to be uniquely selected. Since PC-QTRAK is based on projects or tasks as the fundamental unit, most indexing is focused on the unique "project number" assigned to each task. In PC-QTRAK, each project entered MUST have a "project number."

Each of the .DBF files in the data base contains the actual data corresponding to a QA program management element. For example, the data corresponding to the planning phase of a Technical Systems Audit (TSA) would be stored in the file PLANNING.DBF, and the keys to index the data would be stored in the file PLANNING.NDX. Each pair of files is also coupled with one or more data input screens where the input data for a project are captured and then loaded into the appropriate data base files. The use of dBase III Plus for the data base manager enables great flexibility in the design of the PC-QTRAK data base structure. If additional QA program elements are needed, it is necessary only to create the pertinent files and recompile and re-link the new files to the existing data base.

The standard PC-QTRAK systems contain a set of basic reports for the user. Experience has shown, however, that the reports are almost always the first items to be modified by a new user. The standard reports are listed and defined in Table III. The reports are accessed through a menu screen, and all reports use the compressed print feature so that all information can be displayed on an 8.5 by 11 in. (22 by 28 cm) page. While 20 standard reports are defined, the actual number of different reports possible is much larger. By using dBase to generate the reports, PC-QTRAK allows the user to utilize all of

the data qualification features in dBase to vary the data selection criteria. For example, the QAO may want to list the Master Project Summary reports for a specific division. The FOR qualifier in dBase allows the QAO to specify the selection of certain data records where the division name is given. dBase will produce Master Project Summary only for the records containing the division name requested. In addition, dBase allows the use of logical operators (e.g., AND, OR, NOR) in the FOR statement. This results in an almost limitless array of reports that the QAO can request from PC-QTRAK and have them produced immediately.

## USE OF PC-QTRAK

To facilitate the use of PC-QTRAK, an extensive HELP function has been incorporated into the data base. The HELP function may be activated from any screen by pressing the F1 function key. HELP is automatically indexed to the current data field on the screen. For example, if F1 is pressed while the active field is Project Number, the HELP screen will appear and define the field and explain the format required for data entry. When the user is finished with the HELP screen, pressing the Escape key (ESC) will return the user to the data screen. This facility allows the user to work with the data base without having written documentation close at hand, and is the kind of user aid that would not have been available with a mainframe system because of the computer time costs involved.

A demonstration disk, QTDEMO, allows potential users with PCs to see the data screen formats with explanations of the data fields and the available program options. Like PC-QTRAK itself, QTDEMO makes extensive use of color to present the data screens. It is recommended that both QTDEMO and PC-QTRAK be used on a system with a color monitor; however, both will perform satisfactorily on a monochrome monitor. Further, it is recommended that PCQTRAK be used on a PC-AT (or compatible) system with 512K RAM. While the system will run on a PC-XT (or equivalent), the speed advantage of the PC-AT becomes increasingly important as the size of the data base increases.

## CURRENT STATUS OF PC-QTRAK

PC-QTRAK is presently operational in a standard Regional Office configuration and a standard ORD Laboratory/National Program Office configuration. The standard versions serve as a basis for modifications to accommodate special data fields and formats needed by the user QA organization. PC-QTRAK is presently in use in two EPA Regions and in three EPA research laboratories. At least two other Laboratories, four Program Offices, and four Regions are presently evaluating PC-QTRAK for application to their QA programs.

SUMMARY

PC-QTRAK has evolved from a mainframe-computer-based QA management tracking system in an EPA research laboratory to a highly sophisticated microcomputer-based management information system. The concept of an automated tracking system for QA activities has been demonstrated through a Regional pilot program and through actual operational experience in five EPA organizations. The design of PC-QTRAK reflects generic elements common to any QA management program. This suggests that the concept utilized by PC-QTRAK may be expanded beyond EPA to other organizations whose QA programs involve the need to monitor extensive QA/QC activities conducted on environmental data collection programs.

Table I. PC-QTRAK data base files and contents

| | File | Contents |
|---|---|---|
| 1. | QTRAK.DBF | QTRAK core data base; project information, key milestone dates, key personnel, etc. |
| 2. | QAPP.DBF | QAPP data base; data on QAPP reviews and evaluations, due dates, etc. |
| 3. | PLANNING.DBF | QA audit planning phase data base; data on the planning aspects of audits, including audit team assigned, schedule, etc. |
| 4. | CONDUCT1.DBF | QA audit conduction phase I data base; data on the audit results and evaluation. |
| 5. | CONDUCT2.DBF | QA audit conduction phase II data base; data from any needed follow-up audit. |
| 6. | REPORTIN.DBF | QA audit reporting phase data base; data on the results and findings from the audit to be reported. |
| 7. | PRO_PUB.DBF | Proposed publications data base; data on reports under review for QA/QC documentation requirements, due dates, etc. |
| 8. | PRE_AWD.DBF | QTRAK pre-award data base; data on pre-award audit evaluations for contracts. |
| 9. | CAR.DBF | Corrective Action Recommendations (CAR) data base; data requested corrective actions based on audit findings. |
| 10. | QSR.DBF | Quality Summary Report data base; data on quartely status of project QA/QC activities. |

Table II. PC-QTRAK index files/key fields

| | Index File | Key Field |
|---|---|---|
| 1. | QTRAK.NDX | Project number |
| 2. | QAPP.NDX | Project number + QAPP number |
| 3. | PLANNING.NDX | Project number + QA audit number |
| 4. | CONDUCT1.NDX | Project number + QA audit number |
| 5. | CONDUCT2.NDX | Project number + QA audit number |
| 6. | REPORTIN.NDX | Project number + QA audit number |
| 7. | PRO_PUB.NDX | Project number + proposed publication number |
| 8. | PRE_AWD.NDX | Project number |
| 9. | CAR.NDX | Project number + QA audit number + Corrective Action Recommendation (CAR) numbers |
| 10. | QSR.NDX | Project Number + Quarter + Fiscal Year |

Table III. PC-QTRAK reports

| Report ID | Report Title - Description |
|---|---|
| 1 | MASTER PROJECT SUMMARY - Provides all core data for each project. The report is ordered by project number, division, branch, and project officer. Each page of the report covers one project. |
| 2 | PROJECT OFFICER AUDIT SUMMARY (Planning Phase) - Provides all information associated with any QA audits planned for a particular project. The data are sorted by project officer, division, branch, and project number. |
| 2A | PROJECT OFFICER AUDIT SUMMARY (Conduction Phase I) Provides all information associated with any QA audits in conduction phase I for a particular project. The data are sorted by project officer, division, branch, and project number. |
| 2B | PROJECT OFFICER AUDIT SUMMARY (Conduction Phase II) Provides all information associated with any QA audits in conduction phase II for a particular project. The data are sorted by project officer, division, branch, and project number. |

(continued)

Table III. (cont.)

| Report ID | Report Title - Description |
|---|---|
| 3 | PRE-AWARD SUMMARY - Provides a summary of the proposal package information and pre-award audit evaluation results for all selected projects. |
| 6A | AUDIT REPORTING-PLANNING PHASE - Provides all information associated with any QA audits planned for a particular project. The data are sorted by project officer, division, branch, and project number. |
| 6B | AUDIT REPORTING-CONDUCTION PHASE I - Summarizes all information associated with any QA audits in conduction phase I for a particular project. The data are sorted by project officer, division, branch, and project number. |
| 6C | AUDIT REPORTING-CONDUCTION PHASE II - Summarizes all information associated with any QA audits in conduction phase II for a particular project. The data are sorted by project officer, division, branch, and project number. |
| 10 | QAPP LOG -- Summarizes all projects listed in the QAPjP data base. This report is ordered by project officer and project number. |
| 11 | QAPP LOG (Active Projects Only) - Summarizes only the active projects in the QAPjP data base. This report is ordered by project officer and project number. |
| 12 | QAPP LOG (Branch Sorted) - Summarizes all projects in the QAPjP data base sorted by branch. Each branch is listed on a separate page or pages. This report is also ordered by division, project officer, and project number. |
| 14 | TRACKING REPORT (Project Number Sort) - Summarizes QAPjP reviews and audits for each project. This report is ordered by project number. |
| 15 | TRACKING REPORT (Project Officer Sort) - Summarizes QAPjP reviews and audits for each project. This report is ordered by project officer and project number. |
| 16 | TRACKING REPORT (Project Status Code Sort) - Summarizes QAPjP reviews and audits for each project. This report is ordered by project status code and project number. |
| 17 | TRACKING REPORT (Contractor Sort) - Summarizes QAPjP reviews and audits for each project. This report is ordered by contractor name and project number. |

(continued)

Table III.(Cont.)

| Report ID | Report Title - Description |
|---|---|
| 18 | TRACKING REPORT (Branch/Division Sort) - Summarizes QAPjP reviews and audits for each project. This report is ordered by division, branch, and project number. |
| 19 | TRACKING REPORT (Project Category Sort) - Summarizes QAPjP reviews and audits for each project. This report is ordered by project category and project number. |
| 20 | STATISTICAL REVIEW OF PROJECTS - Summarizes the status of all projects in the data base with respect to QA management milestones and deliverables. The report is ordered by division, branch, project officer, and status code. Each status code pertains to a specific milestone or deliverable. |

REFERENCE

1. EPA Order 5360.1, "Mandatory Quality Assurance Program for the U.S. EPA," U.S. Environmental Protection Agency (April 17, 1984).